

# Robert Miller, MD

Dr. Miller discovered many neurocircuitry operations in the retina.



## 1. What is your background?

I received my medical degree from the University of Utah College of Medicine and performed my postdoctoral work at Johns Hopkins University, in Baltimore. I served 2 years in the US Navy before beginning my professional career as an Assistant Professor at the State University of New York at Buffalo. From there, I served as an Associate/ Full Professor in the Ophthalmology and Physiology Departments at Washington University, in St. Louis. In 1988, I moved on to assume the Chair of Physiology at the University of Minnesota Medical School and the 3M (St. Paul, MN) Bert Cross Chair in Visual Neuroscience. I stepped down as the Chair of Physiology in 1998 and moved to the new department of Neuroscience.

## 2. How did you make the jump from ophthalmology to neuroscience?

I have performed science research in the retina throughout my career and found there was little difference in my research activities in both ophthalmology and physiology. Additionally, I take interest in how the structure of a cell determines its function. Even as a medical student, I was fascinated with how this little piece of tissue, the retina, had so much processing power packed into its constrained space. It was the compelling nature of these questions, and the fascination with the retina as one part of the central nervous system where these issues could be approached, that engendered my enthusiasm to pursue these issues.

## 3. How do you hope that your discoveries will play out in terms of practical application?

Although we have improved our ability to treat diseases like diabetic retinopathy and glaucoma, we need to learn more about the critical role that glutamate—the major excitatory neurotransmitter in the retina and brain—plays in disease conditions. We are now on the threshold of under-

standing whether the activation of specific receptors in the retina can pose a risk for certain clinical conditions, as well as how these events are regulated and/or triggered.

Additionally, we are beginning to appreciate that many degenerative diseases in the nervous system may be created by environmental alterations that are unfavorable for neurosurvival. We need to explore this in greater detail to understand whether these issues can be exploited for treating and preventing retinal diseases.

## 4. Which of the discoveries or scientific advances that you have played a role in do you feel has been the most significant?

I believe I am best known in the retina community for my work on glutamate receptors, including my work on identifying the mGluR6 receptor, which is critical for getting light information from the retina to the brain. This was revealed by using a pharmacological agent called 2-amino-4-phosphobutanoic acid (APB), which has subsequently become a very useful tool for separating information channels in the retina that relate to positive, versus negative contrast images. This work was done in collaboration with my colleague Malcom Slaughter, PhD. This APB drug also revealed the first metabotropic receptor in the entire nervous system.

Additionally, I have developed computational techniques showing the structure-function correlations of the microscopic anatomy of the dendritic branching patterns of amacrin and ganglion cells. Basically, this research changed our perspective on how the retina communicates with the brain.

I have also maintained a long-standing interest in glial cell function and, most recently, glial cells control neuronal sensitivity through modulation of glutamate receptors.

## 5. You have maintained a strong commitment to teaching and research training throughout your career. What have you taken away from your time with students?

In order to enjoy this field, you have to have a high level of enthusiasm and a commitment not only to research, but to training and teaching as well. For the most part, people who are making progress in their field are doing so with the numerous contributions of the students and postdoctorate candidates in their lab. I have always been gratified that the very best people coming through my lab have remained in the field of retina research. Many are now recognized leaders in retina research and have carved out wonderful careers. That is one of my most gratifying experiences. I believe in many ways working with these incredibly talented and creative people has benefited me as much, or more, than my teaching has benefited them. ■